JP2001053644

PATENT ABSTRACTS OF JAPAN

(11)Publication number : **2001-053644**

(43)Date of publication of application : **23.02.2001**

(51)Int.CI. H04B 1/707

(21)Application number : **11-229702**

(22)Date of filing : **16.08.1999**

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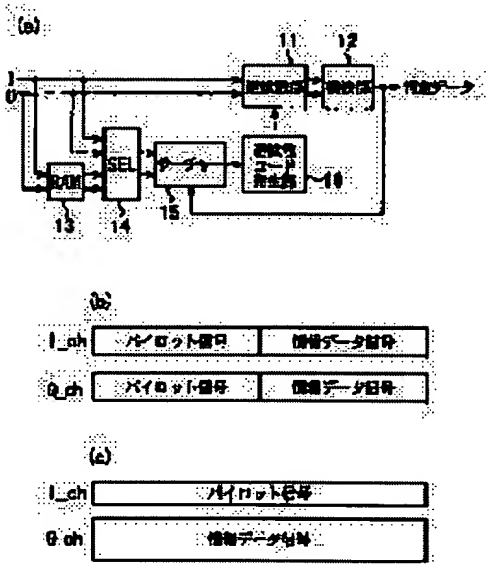
(54) CDMA RECEPTION DEVICE EQUIPPED WITH DECISION FEEDBACK TYPE SEARCHER



(57)Abstract:
PROBLEM TO BE SOLVED: To enable a CDMA reception device, equipped with a decision feedback type searcher for detecting the synchronism timing (path timing) to a spread code series in a receive signal to precisely detect the path timing even with a signal having a low S/N ratio.
SOLUTION: This system is equipped with the searcher 15 to which a prescribed pilot signal transmitted from a transmission side and an information data signal passed through a delay buffer 13 are inputted through a selection part 14. Decision data detected by a detection part 12 are inputted to the searcher 15, which detects the path timing by using the decision data and information data signal together with the pilot signal and outputs the path timing to a reverse spread code generation part 16, which generates a reverse spread code in the path timing. Further, the system is equipped with constitution for correcting errors of the decision data and making

a CRC check and detecting and outputting the path timing corresponding to the reliability of the decision data.

LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

CLAIMS

[Claim(s)]

[Claim 1] In the CDMA receiving set equipped with the searcher which receives the fixed pilot signal transmitted from a transmitting side, and detects synchronous timing with the diffusion code sequence in an input signal based on this pilot signal A means to return to a searcher the judgment data which receive and carry out the back diffusion of electrons of the information data signal transmitted from a transmitting side, and are detected and obtained after this back diffusion of electrons, It has a means to input the received this information data signal into this searcher through a delay buffer. The CDMA receiving set possessing the judgment feedback form searcher which carries out electrical-potential-difference addition of the correlation output for every symbol of the predetermined section of said information data signal, and is characterized by having the searcher which detects and outputs synchronous timing with the diffusion code sequence in an input signal using those electrical-potential-difference aggregate values.

[Claim 2] Said CDMA receiving set receives the pilot signal which Time Division Multiplexing is carried out to an information data signal, and is transmitted to it. And the predetermined section length of said information data signal It considers as die length without the effect of the phase rotation by phasing. Said searcher The CDMA receiving set possessing the judgment feedback form searcher according to claim 1 characterized by detecting and outputting said synchronous timing based on the correlation value which carried out power addition of the electrical-potential-difference aggregate value of the correlation output of said pilot signal and an information data signal.
[Claim 3] Said CDMA receiving set receives the pilot signal transmitted in parallel to coincidence by the channel other than the channel to which an information data signal is transmitted. The predetermined section length of said information data signal considers as die length without the effect of the phase rotation by phasing. And said searcher The correlation value which carried out power addition of the electrical-potential-difference aggregate value of the correlation output of said pilot signal of the same timing, and an information data signal Furthermore, the CDMA receiving set possessing the judgment feedback form searcher according to claim 1 characterized by detecting and outputting said synchronous timing based on the correlation value which continued at two or more time amount sections, and carried out power addition.
[Claim 4] An error correction means to perform an error correction based on an error correcting code to said judgment data, The CRC-check means which carries out CRC check of these data that carried out the error correction, It has an error rate presumption means to presume the error rate for every error correcting code-ized unit frame of said judgment data. The error rate estimate for every error correcting code-ized unit frame of these judgment data or the CRC-check judging result of these data that carried out the error correction is returned to said searcher. Said searcher The CDMA receiving set possessing the judgment feedback form searcher according to claim 1 to 3 characterized by having a means to output said synchronous timing according to the reliability of said judgment data, based on this error rate estimate or this CRC-check judging result.
[Claim 5] When said CRC-check judging result is with an error, or when said error rate estimate is beyond a predetermined value Said searcher is equipped with a means to prevent the output of said synchronous timing detected with this error correcting code-ized unit frame. Said CDMA receiving set It is a CDMA receiving set possessing the judgment feedback form searcher according to claim 4 characterized by performing back-diffusion-of-electrons processing based on the synchronous timing outputted last time when synchronous timing is not outputted from a searcher.
[Claim 6] Said searcher is a CDMA receiving set possessing the judgment feedback form searcher according to claim 4 characterized by having a means to carry out weighting to the correlation value for this every error correcting code-ized unit frame, according to the error rate estimate for said every error correcting code-ized unit frame.
[Claim 7] Said searcher is a CDMA receiving set possessing the judgment feedback form searcher according to claim 6 characterized by computing a weighting factor and carrying out the multiplication of this weighting factor to the correlation value for said every error correcting code-ized unit frame based on the number of errors which the error rate estimate for said every error correcting code-ized unit frame shows.
[Claim 8] Said searcher is a CDMA receiving set possessing the judgment feedback form searcher according to claim 4 to 7 characterized by having a means to output said

synchronous timing according to this presumed passing speed, with reference to the presumed passing speed of a migration machine when it is beyond a value with all the numbers of errors of each error correcting code-ized unit frame.
[Claim 9] It is a CDMA receiving set possessing the judgment feedback form searcher according to claim 8 characterized by having a means to prevent the output of said synchronous timing when said presumed passing speed is more than a certain predetermined rate.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the CDMA receiving set which detects pass timing with a sufficient precision also by the signal of a low S/N ratio especially about the CDMA receiving set equipped with the judgment feedback form searcher for detecting synchronous timing (pass timing) with the diffusion code sequence in an input signal.
[0002] When a direct-spread-code-division-multiple-access (DS-CDMA) method is applied to mobile communication, the function of the searcher which outputs the synchronous timing of the back-diffusion-of-electrons code for detecting the receiving timing of an input signal and carrying out the back diffusion of electrons of the input signal is an indispensable function in a CDMA receiving set.
[0003] In a DS-CDMA method, in order to obtain more channel capacity, rake reception and an error correction technique are used and the transmitted power per each channel is reduced as much as possible. Therefore, also in the searcher of a CDMA receiving set, the stable actuation under a low signal-to-noise ratio (S/N) is called for.
[0004]
[Description of the Prior Art] Drawing 11 is the explanatory view of the pass timing detection by the conventional pilot signal. The technique of the pass timing detection by the conventional pilot signal transmitted the pilot signal of a fixed data pattern with the transmit information data signal from the transmitting side, and the searcher in a CDMA receiving set measured correlation with the received pilot signal and a fixed data pattern using slide correlator or a matched filter, presumed the phase of an input signal based on the correlation value, and has detected pass timing.
[0005] As the insertion approach of a pilot signal, as shown in (a) of drawing 11 R> 1 As Time Division Multiplexing of a pilot signal and the transmit information data signal is carried out and a pilot signal is indicated to be the pilot signal interpolation form interpolated and transmitted between transmit information data signals to (b) of drawing There are two kinds of approaches with the pilot signal extrapolation form where a pilot signal and a transmit information data signal are transmitted in parallel using I channels which go direct mutually for example, respectively, and Q channels.
[0006] However, since a pilot signal is also influenced of a noise on a propagation path, in order to reduce the effect of the noise As shown in (a) of drawing in the case of a pilot signal interpolation form, and as shown in (b) of drawing in the case of a pilot signal

extrapolation form In order to carry out electrical-potential-difference addition of the correlation output for every symbol within this section and to remove the effect of the level variation by phasing etc. for every predetermined pilot signal section Power addition of the electrical-potential-difference aggregate value for some of every pilot signals is carried out, distribution is made small, improvement in the S/N ratio of the input signal in pass timing detection is aimed at, and the precision of the pass timing detection under a lower S/N ratio is raised.

[0007]

[Problem(s) to be Solved by the Invention] Since the signaling bit energy pair noise power spectral density ratio (Eb/No) which fills a necessary permissible error rate is falling increasingly by advance of error correction techniques (Viterbi decoding, turbo decode, etc.) in recent years, it is required under the very low signal-to-noise ratio (S/N) that pass timing should be detected.

[0008] In order to detect pass timing, under a low signal-to-noise ratio (S/N), it is necessary to perform electrical-potential-difference addition of the correlation output for every symbol of the, and power addition of the electrical-potential-difference aggregate value, to reduce the effect by the noise using more pilot signals, and to raise the precision of detection of pass timing.

[0009] However, if the insertion ratio of a pilot signal is enlarged in a pilot signal interpolation form, since the number of signals which can be used for pass timing detection will increase, the pass timing detection stabilized more is attained, but in order [the] to carry out part reduction, as for the information amount of data transmitted as communication link information, channel capacity decreases as a result.

[0010] Moreover, although the precision of pass timing detection can also be raised using the pilot signal over much sections, without gathering the insertion ratio of a pilot signal, the time amount which a part for the time amount which receives the pilot signal of much sections, and a pass search take becomes long, and delay of communicative initiation will be brought about.

[0011] Moreover, since in the case of a pilot signal extrapolation form it will influence as a noise to the information data signal under transmission if the transmitted power of a pilot signal is made to increase although it is necessary to a transmit information data signal to enlarge transmitted power of a pilot signal for the transmitted power of a pilot signal is very weak and raising the precision of pass timing detection, it is necessary to reduce the transmitted power of a pilot signal as much as possible.

[0012] This invention aims at offering the CDMA receiving set which equipped Takatoo with the searcher which detects pass timing so that it may not be influenced by the pass by migration of a receiving set of fluctuation, while it detects the timing of pass stably under a very low signal-to-noise ratio (S/N), without increasing the number of pilot signals, and its transmitted power.

[0013]

[Means for Solving the Problem] The CDMA receiving set possessing the judgment feedback form searcher of this invention (1) In the CDMA receiving set equipped with the searcher which receives the fixed pilot signal transmitted from a transmitting side, and detects synchronous timing with the diffusion code sequence in an input signal based on this pilot signal A means to return to a searcher the judgment data which receive and carry out the back diffusion of electrons of the information data signal transmitted from a

transmitting side, and are detected and obtained after this back diffusion of electrons, It has a means to input the received this information data signal into this searcher through a delay buffer. Electrical-potential-difference addition of the correlation output for every symbol of the predetermined section of said information data signal is carried out, and it has the searcher which detects and outputs synchronous timing with the diffusion code sequence in an input signal using those electrical-potential-difference aggregate values.
[0014] The timing of pass can be detected with a sufficient precision under a low signal-to-noise ratio (S/N) by performing electrical-potential-difference addition, without using an information data signal on a par with a pilot signal, and increasing the number of pilot signals by this configuration.
[0015] (2) -- said CDMA receiving set receives the pilot signal which Time Division Multiplexing is carried out to an information data signal, and is transmitted to it, and the predetermined section length of said information data signal makes it die length without the effect of the phase rotation by phasing, and said searcher detects and outputs said synchronous timing based on the correlation value which carried out power addition of the electrical-potential-difference aggregate value of the correlation output of said pilot signal and an information data signal. [moreover,]
[0016] Said CDMA receiving set receives the pilot signal transmitted in parallel to coincidence by the channel other than the channel to which an information data signal is transmitted. (3) -- [moreover,] The predetermined section length of said information data signal considers as die length without the effect of the phase rotation by phasing. And said searcher Said synchronous timing is detected and outputted based on the correlation value which continued at further two or more time amount sections, and carried out power addition of the correlation value which carried out power addition of the electrical-potential-difference aggregate value of the correlation output of said pilot signal of the same timing, and an information data signal.
[0017] (4) -- with an error correction means to perform an error correction based on an error correcting code to said judgment data [moreover,] The CRC-check means which carries out CRC check of these data that carried out the error correction, It has an error rate presumption means to presume the error rate for every error correcting code-ized unit frame of said judgment data. The error rate estimate for every error correcting code-ized unit frame of these judgment data or the CRC-check judging result of these data that carried out the error correction is returned to said searcher. Said searcher Based on this error rate estimate or this CRC-check judging result, it has a means to output said synchronous timing according to the reliability of said judgment data. This configuration can estimate the reliability of judgment data and the high synchronous timing of precision can be outputted by it according to the reliability of judgment data.
[0018] (5) -- when said CRC-check judging result is with an error, or when said error rate estimate is beyond a predetermined value, said searcher is equipped with a means prevent the output of said synchronous timing detected with this error correcting code-ized unit frame, and said CDMA receiving set performs back-diffusion-of-electrons processing based on the synchronous timing outputted last time, when synchronous timing is not outputted from a searcher. [moreover,]
[0019] (6) -- said searcher is a preparation thing about a means to carry out weighting to the correlation value for this every error correcting code-ized unit frame according to the error rate estimate for said every error correcting code-ized unit frame. [moreover,]

[0020] (7) -- based on the number of errors which the error rate estimate for said every error correcting code-ized unit frame shows, said searcher computes a weighting factor and carries out the multiplication of this weighting factor to the correlation value for said every error correcting code-ized unit frame. [moreover,]
[0021] (8) -- said searcher is equipped with a means to output said synchronous timing according to this presumed passing speed, with reference to the presumed passing speed of a migration machine, when it is beyond a value with all the numbers of errors of each error correcting code-ized unit frame. [moreover,] (9) -- when said presumed passing speed is more than a certain predetermined rate, it has a means to prevent the output of said synchronous timing. [moreover,]
[0022] Since the judgment information data used by the searcher are data before an error correction (this invention uses the judgment data before an error correction since the time delay is large although the direction of the data after an error correction has few errors.), the information data by which the misjudgment law was carried out exist to some extent.
[0023] Then, error rate presumption is performed after an error correction, and the judgment information data quality check used for pass presumption is performed. And pass timing is detectable with a sufficient precision by determining adoption and the rejection of the pass timing result presumed with judgment information data by the quality check result.
[0024]
[Embodiment of the Invention] Drawing 1 is the explanatory view of the basic configuration of this invention. The back-diffusion-of-electrons section 11 to which the CDMA receiving set of this invention carries out the back diffusion of electrons of the input signal as shown in (a) of drawing, The detection section 12 which detects the signal which carried out the back diffusion of electrons, and the delay buffer 13 with which the received input signal is accumulated temporarily and delayed, The selection section 14 which chooses and outputs one of these out of the information data signal accumulated in the delay buffer 13, and the pilot signal under current reception, It has the searcher 15 which detects and outputs pass timing from the output signal of the selection section 14, and the back-diffusion-of-electrons code generating section 16 which generates a back-diffusion-of-electrons code based on the output signal of a searcher 15.
[0025] The information data signal accumulated in the delay buffer 13 is inputted into a searcher 15 through the selection section 14, and he returns the judgment data which are the output of the detection section 12 to a searcher 15, and is trying for a searcher 15 to detect pass timing like a pilot signal based on those input signals in the CDMA receiving set of this invention using an information data signal.
[0026] In the pass timing detection in a searcher 15, when using a pilot signal, the selection section 14 carries out the direct output of the pilot signal included in either [of those] both I channels or Q channels of an input signal to a searcher 15. Since a pilot signal is a pattern signal defined beforehand, a searcher 15 measures correlation with the received pilot signal and a known pattern signal.
[0027] Moreover, when using receipt information data, the selection section 14 chooses the receipt information data stored in the delay buffer 13 temporarily, and outputs them to a searcher 15, and a searcher 15 measures correlation with these receipt information data and the judgment data of these receipt information data outputted from the detection section 12.

[0028] In addition, (b) of drawing 1 shows the example of the input signal in I in the case of a pilot signal interpolation form, and Q channels, and (c) of drawing shows the example of the input signal in I in the case of a pilot signal extrapolation form, and Q channels.

[0029] Drawing 2 is the explanatory view of the delay buffer of the input signal in above-mentioned this invention. (a) of drawing shows the configuration which took out the chief section of the configurations of being shown in drawing 1 , (b) of drawing shall show the timing diagram of each signal frame of the A point shown in (a) of drawing, a B point, and C point, the number attached in each signal frame shall show the slot number, and one slot shall consist of data of for example, ten symbols.

[0030] In case information data are used for detection of pass timing in a searcher 15, since the received information data are strange data, they need to carry out the back diffusion of electrons of these information data by the back-diffusion-of-electrons section 11 and the detection section 12, need to detect them, and need to judge information data.

[0031] However, as show in (b) of drawing, in order [which judgment processing take] to carry out time amount part (part for for example, 20 symbols) delay, that the judgment data be send out from C point of the output of the detection section 12 need to incorporate the information data in signal of an A point to the delay buffer 13, it need to delay by the delay (a part for for example, the 20 above-mentioned symbol), need to input into a searcher 15 the signal of the B point which be the output, and need to double timing.

[0032] Therefore, this information data signal is inputted into a searcher 15 to the timing from which judgment data return to a searcher 15. In addition, the above-mentioned delayed part is time amount which phase presumption mainly takes, and when starting phase presumption in much time amount, a time delay becomes large so much.

[0033] Drawing 3 is the explanatory view of the correlation measurement which uses the correlation output for every predetermined section of the information data signal of this invention. (a) of drawing shows the case of a pilot signal interpolation form, it is drawing (b-1), and (b-2) of drawing shows the case of a pilot signal extrapolation form. As shown in drawing, electrical-potential-difference addition of the correlation output with the judgment data for every predetermined section is carried out to an information data signal, respectively, power addition of the electrical-potential-difference aggregate value of each section is carried out after that, and pass timing is detected.

[0034] From the input signal of a pilot signal interpolation form, when a searcher has only one line like the operation gestalt shown in drawing 1 , as shown in (a) of drawing 3 , to a pilot signal and an information data signal, electrical-potential-difference addition of the correlation value for every symbol is performed, this electrical-potential-difference aggregate value power addition is carried out for every predetermined section, and the small correlation value of distribution is calculated.

[0035] Moreover, since the correlation value of a pilot signal and an information data signal cannot be detected to coincidence to the input signal of a pilot signal extrapolation form when a searcher has only one line, as shown in (b-1) of drawing 3 , a correlation value is measured only to an information data signal. However, the time of communication link initiation etc. performs pass detection using a pilot signal, when it is in the condition that an information data signal is not outputted.

[0036] On the other hand, to the input signal of a pilot signal extrapolation form, when a

searcher can detect two signals, as shown in (b-2) of drawing 3 , electrical-potential-difference addition is performed for the pilot signal and information data signal of the same time of day for every (every slot) block, respectively, power addition of the electrical-potential-difference aggregate values of the PAROTTO signal for every block of the same time amount section and information data is carried out after that, and power addition is further performed with the power aggregate values of some blocks. Even in this case, although electrical-potential-difference addition is performed per data block of the predetermined time amount section, let this data block unit be the optimal section length without the effect of the phase rotation by phasing.

[0037] Drawing 4 shows the operation gestalt of this invention which has the searcher which detects two signals. A searcher 45 is equipped with the correlating detector 451 for pilot signals, the correlating detector 452 for information data signals, and the adder 453 that carries out power addition of the correlation electrical-potential-difference aggregate value from those correlating detectors in this drawing. Since other components are the same as that of the thing in the configuration shown in drawing 1 , the explanation which attached the same sign and overlapped is omitted.
 [0038] Detection of correlation by such addition can perform electrical-potential-difference addition in the block unit corresponding to the frame and slot length of W-CDMA to which the present standardization is progressing. That is, since the signal length and period which are predicted that a pilot signal is a signal transmitted in order to make phase presumption of a channel perform, and originally does not usually have the effect of the phase rotation by phasing which happens in a migration environment are set up, correlation is detectable with a sufficient precision by performing electrical-potential-difference addition for every block of a pilot signal.

[0039] Drawing 5 is the explanatory view of the configuration of this invention which returns an error rate and a CRC-check result. The configuration shown in drawing 5 is equipped with the configuration which feeds back the error rate (BER) value for every frame of an error correcting code-ized unit, and the yes-no decision result of this frame by CRC check to a searcher 15 besides the basic configuration shown in drawing 1 .

[0040] That is, the error REITO (BER) presumption section 54 which compares with recoding data and judgment data the error correction section 51 which performs the error correction of the judgment data outputted from the detection section 12, the CRC-check section 52 which performs CRC check of data which performed this error correction, and the recoding section 53 which carries out recoding of the data which performed the error correction, and presumes error REITO is newly formed.

[0041] And by the CRC-check section 52, CRC check is performed per error correction frame, and it investigates whether the error was in each frame. Moreover, error REITO presumption of judgment data is performed by carrying out recoding of the judgment data after an error correction by the recoding section 53, and comparing the judgment data before an error correction with the recoding data after an error correction in the error rate (BER) presumption section 54. Under the present circumstances, when judged with there being no error in this frame by the yes-no decision of CRC check, perfect error REITO presumption is attained.

[0042] The gestalt of operation shown in drawing 5 returns the yes-no decision result outputted from the number of errors and the CRC-check section 42 for every frame outputted from the error rate (BER) presumption section 54 to a searcher 15, and raises

the precision of the pass timing detection in a searcher 15. Hereafter, the concrete means is explained.

[0043] Drawing 6 is the explanatory view of pass timing detection of the error correcting code-ized unit of the pilot signal interpolation form by this invention. As shown in this drawing, while performing electrical-potential-difference addition of the correlation value per block of the predetermined length of a pilot signal and an information data signal, the correlation value which carried out power addition of this electrical-potential-difference aggregate value per error-correcting-code-izing, and carried out power addition of the power aggregate value of some correction coding units further is inputted into the pass detector 61 of a searcher 15.

[0044] The output of the pass detector 61 is inputted into the pass timing sending-out gate 62, and the error REITO estimate of the yes-no decision result of the above-mentioned CRC-check section 52 and the error REITO (BER) presumption section 54 is inputted into the pass timing sending-out gate 62. The pass timing sending-out gate 62 determines as follows whether output a pass timing detection result to the back-diffusion-of-electrons code generating section 16 based on these yes-no decision result or error REITO estimate.

[0045] Since I hear that there is an error and it is to the extent that an error correction is impossible for the judgment data which returned to the searcher 15 when the result of CRC check is an error, it considers that the reliability of the pass detection by these information data is low, the pass timing sending-out gate 62 is intercepted, and the pass timing detection result is not made to reflect to the back-diffusion-of-electrons code generating section 16. In addition, the back-diffusion-of-electrons code generating section 16 generates a back-diffusion-of-electrons code succeedingly to the last pass timing, when a pass timing detection result is not inputted.

[0046] When are judged with it being errorless by CRC check and error REITO presumed from recoding data and judgment data becomes beyond a certain value, it considers that the reliability of pass detection is low, the pass timing sending-out gate 62 is intercepted, and the pass timing detection result is not made to reflect to the back-diffusion-of-electrons code generating section 16.

[0047] Drawing 7 is the explanatory view of the pass timing detection by weighting according to error REITO in the case of the pilot signal interpolation form of this invention. As shown in this drawing, while performing electrical-potential-difference addition of the correlation value per block of the predetermined length of a pilot signal and an information data signal Power addition of this electrical-potential-difference aggregate value is carried out per error-correcting-code-izing, and it is the correlation value of the power aggregate value of this error correcting code-ized unit, respectively The correlation value memory 711, 712, and 713 It memorizes. And weighting (W1, W2, W3) according to the error REITO (BER) estimate for every error correcting code-ized unit is carried out to the correlation value of each of this error correcting code-ized unit. The correlation value which carried out power addition of the correlation value of each error correcting code-ized unit which performed this weighting is inputted into the pass detector 73.

[0048] The wait control section 72 outputs the weighting multiplier (W1, W2, W3) according to the error REITO (BER) estimate for every error correcting code-ized unit, and the error REITO (BER) estimate for every error correcting code-ized unit is

computed by the error REITO (BER) presumption section 54 shown in above-mentioned drawing 5 . In addition, the correlation value memory 711 which memorizes the correlation value for every error correcting code-ized unit since time gap arises between each error correcting code-ized unit, although error REITO for every error correcting code-ized unit is computed, 712, and 713 It is necessary to have.

[0049] Drawing 8 is the explanatory view of pass timing detection of the error correcting code-ized unit of the pilot signal extrapolation form by this invention. The gestalt of this operation inputs into the pass detector 81 of a searcher 15 the correlation value which performed electrical-potential-difference addition of a correlation value per block of the predetermined length of a pilot signal and an information data signal, respectively, carried out power addition of the electrical-potential-difference aggregate value of the correlation value of a pilot signal and an information data signal by the blocks of the same timing, and carried out power addition of those power aggregate values per error-correcting-code-izing, and carried out power addition of the power aggregate value of the correction coding unit of further some further.

[0050] Like the gestalt of operation shown in drawing 6 also in this case, the output of the pass detector 81 is inputted into the pass timing sending-out gate 72, and the error REITO estimate of the yes-no decision result of the CRC-check section 42 and the error REITO (BER) presumption section 54 is inputted into the pass timing sending-out gate 82.

[0051] The pass timing sending-out gate 82 determines whether output a pass timing detection result to the back-diffusion-of-electrons code generating section 16 based on these yes-no decision result or error REITO estimate. Although the explanation which overlapped since the decision technique was the same as the case of the pilot interpolation form shown in drawing 6 is omitted, the reflection to the back-diffusion-of-electrons code generating section 16 of a pass timing detection result is similarly controlled by the CRC-check result or the error REITO value.

[0052] Drawing 9 is the explanatory view of the pass timing detection by error REITO weighting in the case of the pilot signal extrapolation form of this invention. As shown in drawing, electrical-potential-difference addition of a correlation value is performed per block of the predetermined length of a pilot signal and an information data signal, respectively. And power addition of the electrical-potential-difference aggregate value of the correlation value of the pilot signal of the same timing blocks and an information data signal is carried out. And it is the correlation value which carried out power addition of those power aggregate values per error-correcting-code-izing, and carried out this power addition The correlation memory 911, 912, and 913 It memorizes. And weighting (W1, W2, W3) according to the error REITO (BER) estimate for every error correcting code-ized unit is carried out to the correlation value of each of that error correcting code-ized unit. The correlation value which carried out power addition of the correlation value of each error correcting code-ized unit which performed this weighting is inputted into the pass detector 93.

[0053] The wait control section 92 outputs the weighting factor (W1, W2, W3) according to the error REITO (BER) estimate for every error correcting code-ized unit like the gestalt of operation shown in drawing 6 , and the error REITO (BER) estimate for every error correcting code-ized unit is computed by the error REITO (BER) presumption section 54 shown in above-mentioned drawing 5 . In addition, the correlation value memory 911 which memorizes the correlation value for every error correcting code-ized

unit, 912, and 913 It is the same as that of the case of the gestalt of the operation which also showed the reason which it had to above-mentioned drawing 7 .
[0054] Drawing 10 shows the example of the weighting-factor calculation according to the error REITO estimate for every error correcting code-ized unit in this invention. Drawing (a) The example of the weighting-factor calculation approach when not taking into consideration passing speed of a CDMA receiving set is shown, and (b) of drawing shows the example of the weighting-factor calculation approach at the time of taking passing speed into consideration.
[0055] Now if [set the number of errors in each 1st, 2nd, and 3rd error correcting code-ized unit frames to N1, N2, and N3, respectively, and] Z=N1+N2+N3 The 1st, the 2nd and each weighting factor W1 and W2 to the correlation value of the 3rd error correcting code-ized unit frame, and W3 are W1=(Z/N1)/(Z/N1+Z/N2+Z/N3).
W2=(Z/N2)/(Z/N1+Z/N2+Z/N3)
W3=(Z/N3)/(Z/N1+Z/N2+Z/N3)
It computes by carrying out. In addition, it is set to W1+W2+W3=1.
[0056] Each weighting factors W1 and W2 and W3 serve as a value which was in inverse proportion to the number of errors within a self-block, respectively. That is, it becomes the multiplier of such a small value that there are many errors, and becomes the multiplier of such a big value that there are few errors. Thus, the precision of a correlation value can be raised by carrying out the multiplication of the weighting factor according to the inverse number of the number of errors to the correlation value of each block. In addition, although this example shows the example which computes three correlation values using an error correcting code-ized unit frame, of course, a frame number is not limited to this.
[0057] Furthermore, as shown in (b) of drawing, also refer to the presumed passing speed, for example, when N1, N2, and N3 errors of each frame are beyond a certain values altogether When the presumed passing speed V is below a certain rate Vfast, do not reset pass timing but it is made to operate to the last timing with reference to the presumed passing speed V at that time, and it is made to reset when the presumed passing speed V is more than a certain rate Vfast.
[0058] This is because it is more accurate to have considered the pass condition not to change so much, and to perform the back diffusion of electrons to the last pass timing when there are very many errors when the presumed passing speed V is below a certain rate Vfast in many cases.
[0059] In addition, the presumed passing speed V can be presumed by measuring for example, a phasing fluctuation frequency (count to which phasing fluctuation level intersects per unit time amount in a predetermined level value) etc.
[0060] When either with N1, N2, and N3 errors of each frame is below a certain value, pass timing can be detected with a sufficient precision by calculating a weighting factor by the calculation approach as shown in (a) of above-mentioned drawing 9 , and detecting pass timing based on the correlation value which carried out power addition of the correlation value which carried out the multiplication of this weighting factor.
[0061]
[Effect of the Invention] The precision of the pass timing detection under a signal-to-noise ratio (S/N) can be raised without [as explained above, without it enlarges the insertion ratio of a pilot signal by detecting pass timing, using an information data signal like a pilot signal according to this invention, and] making the transmitted power of a

pilot signal increase.
[0062] Moreover, about the judgment data of the received information data signal, an error correction and CRC check are performed, the reliability of feedback judging data is evaluated using the result and error rate estimate of judgment data, when the reliability of these feedback judging data is low, the pass timing detection result detected using the information data signal is deleted, and a setup of more reliable pass timing is enabled.
[0063] Furthermore, the precision of pass timing can be raised by detecting pass timing using two or more correlation values which carried out with weight according to the error REITO estimate of judgment data.

TECHNICAL FIELD

[Field of the Invention] This invention relates to the CDMA receiving set which detects pass timing with a sufficient precision also by the signal of a low S/N ratio especially about the CDMA receiving set equipped with the judgment feedback form searcher for detecting synchronous timing (pass timing) with the diffusion code sequence in an input signal.
[0002] When a direct-spread-code-division-multiple-access (DS-CDMA) method is applied to mobile communication, the function of the searcher which outputs the synchronous timing of the back-diffusion-of-electrons code for detecting the receiving timing of an input signal and carrying out the back diffusion of electrons of the input signal is an indispensable function in a CDMA receiving set.
[0003] In a DS-CDMA method, in order to obtain more channel capacity, rake reception and an error correction technique are used and the transmitted power per each channel is reduced as much as possible. Therefore, also in the searcher of a CDMA receiving set, the stable actuation under a low signal-to-noise ratio (S/N) is called for.

PRIOR ART

[Description of the Prior Art] Drawing 11 is the explanatory view of the pass timing detection by the conventional pilot signal. The technique of the pass timing detection by the conventional pilot signal transmitted the pilot signal of a fixed data pattern with the transmit information data signal from the transmitting side, and the searcher in a CDMA receiving set measured correlation with the received pilot signal and a fixed data pattern using slide correlator or a matched filter, presumed the phase of an input signal based on the correlation value, and has detected pass timing.
[0005] As the insertion approach of a pilot signal, as shown in (a) of drawing 11 R> 1 As Time Division Multiplexing of a pilot signal and the transmit information data signal is carried out and a pilot signal is indicated to be the pilot signal interpolation form interpolated and transmitted between transmit information data signals to (b) of drawing There are two kinds of approaches with the pilot signal extrapolation form where a pilot signal and a transmit information data signal are transmitted in parallel using I channels which go direct mutually for example, respectively, and Q channels.

[0006] However, since a pilot signal is also influenced of a noise on a propagation path, in order to reduce the effect of the noise As shown in (a) of drawing in the case of a pilot signal interpolation form, and as shown in (b) of drawing in the case of a pilot signal extrapolation form In order to carry out electrical-potential-difference addition of the correlation output for every symbol within this section and to remove the effect of the level variation by phasing etc. for every predetermined pilot signal section Power addition of the electrical-potential-difference aggregate value for some of every pilot signals is carried out, distribution is made small, improvement in the S/N ratio of the input signal in pass timing detection is aimed at, and the precision of the pass timing detection under a lower S/N ratio is raised.

EFFECT OF THE INVENTION

[Effect of the Invention] The precision of the pass timing detection under a signal-to-noise ratio (S/N) can be raised without [as explained above, without it enlarges the insertion ratio of a pilot signal by detecting pass timing, using an information data signal like a pilot signal according to this invention, and] making the transmitted power of a pilot signal increase.
[0062] Moreover, about the judgment data of the received information data signal, an error correction and CRC check are performed, the reliability of feedback judging data is evaluated using the result and error rate estimate of judgment data, when the reliability of these feedback judging data is low, the pass timing detection result detected using the information data signal is deleted, and a setup of more reliable pass timing is enabled.
[0063] Furthermore, the precision of pass timing can be raised by detecting pass timing using two or more correlation values which carried out with weight according to the error REITO estimate of judgment data.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] Since the signaling bit energy pair noise power spectral density ratio (Eb/No) which fills a necessary permissible error rate is falling increasingly by advance of error correction techniques (Viterbi decoding, turbo decode, etc.) in recent years, it is required under the very low signal-to-noise ratio (S/N) that pass timing should be detected.
[0008] In order to detect pass timing, under a low signal-to-noise ratio (S/N), it is necessary to perform electrical-potential-difference addition of the correlation output for every symbol of the, and power addition of the electrical-potential-difference aggregate value, to reduce the effect by the noise using more pilot signals, and to raise the precision of detection of pass timing.
[0009] However, if the insertion ratio of a pilot signal is enlarged in a pilot signal interpolation form, since the number of signals which can be used for pass timing

detection will increase, the pass timing detection stabilized more is attained, but in order [the] to carry out part reduction, as for the information amount of data transmitted as communication link information, channel capacity decreases as a result.
[0010] Moreover, although the precision of pass timing detection can also be raised using the pilot signal over much sections, without gathering the insertion ratio of a pilot signal, the time amount which a part for the time amount which receives the pilot signal of much sections, and a pass search take becomes long, and delay of communicative initiation will be brought about.
[0011] Moreover, since in the case of a pilot signal extrapolation form it will influence as a noise to the information data signal under transmission if the transmitted power of a pilot signal is made to increase although it is necessary to a transmit information data signal to enlarge transmitted power of a pilot signal for the transmitted power of a pilot signal is very weak and raising the precision of pass timing detection, it is necessary to reduce the transmitted power of a pilot signal as much as possible.
[0012] This invention aims at offering the CDMA receiving set which equipped Takatoo with the searcher which detects pass timing so that it may not be influenced by the pass by migration of a receiving set of fluctuation, while it detects the timing of pass stably under a very low signal-to-noise ratio (S/N), without increasing the number of pilot signals, and its transmitted power.

MEANS

[Means for Solving the Problem] The CDMA receiving set possessing the judgment feedback form searcher of this invention (1) In the CDMA receiving set equipped with the searcher which receives the fixed pilot signal transmitted from a transmitting side, and detects synchronous timing with the diffusion code sequence in an input signal based on this pilot signal A means to return to a searcher the judgment data which receive and carry out the back diffusion of electrons of the information data signal transmitted from a transmitting side, and are detected and obtained after this back diffusion of electrons, It has a means to input the received this information data signal into this searcher through a delay buffer. Electrical-potential-difference addition of the correlation output for every symbol of the predetermined section of said information data signal is carried out, and it has the searcher which detects and outputs synchronous timing with the diffusion code sequence in an input signal using those electrical-potential-difference aggregate values.
[0014] The timing of pass can be detected with a sufficient precision under a low signal-to-noise ratio (S/N) by performing electrical-potential-difference addition, without using an information data signal on a par with a pilot signal, and increasing the number of pilot signals by this configuration.
[0015] (2) -- said CDMA receiving set receives the pilot signal which Time Division Multiplexing is carried out to an information data signal, and is transmitted to it, and the predetermined section length of said information data signal makes it die length without the effect of the phase rotation by phasing, and said searcher detects and outputs said synchronous timing based on the correlation value which carried out power addition of the electrical-potential-difference aggregate value of the correlation output of said pilot signal and an information data signal. [moreover,]

[0016] Said CDMA receiving set receives the pilot signal transmitted in parallel to coincidence by the channel other than the channel to which an information data signal is transmitted. (3) -- [moreover,] The predetermined section length of said information data signal considers as die length without the effect of the phase rotation by phasing. And said searcher Said synchronous timing is detected and outputted based on the correlation value which continued at further two or more time amount sections, and carried out power addition of the correlation value which carried out power addition of the electrical-potential-difference aggregate value of the correlation output of said pilot signal of the same timing, and an information data signal.
[0017] (4) -- with an error correction means to perform an error correction based on an error correcting code to said judgment data [moreover,] The CRC-check means which carries out CRC check of these data that carried out the error correction, It has an error rate presumption means to presume the error rate for every error correcting code-ized unit frame of said judgment data. The error rate estimate for every error correcting code-ized unit frame of these judgment data or the CRC-check judging result of these data that carried out the error correction is returned to said searcher. Said searcher Based on this error rate estimate or this CRC-check judging result, it has a means to output said synchronous timing according to the reliability of said judgment data. This configuration can estimate the reliability of judgment data and the high synchronous timing of precision can be outputted by it according to the reliability of judgment data.
[0018] (5) -- when said CRC-check judging result is with an error, or when said error rate estimate is beyond a predetermined value, said searcher is equipped with a means prevent the output of said synchronous timing detected with this error correcting code-ized unit frame, and said CDMA receiving set performs back-diffusion-of-electrons processing based on the synchronous timing outputted last time, when synchronous timing is not outputted from a searcher. [moreover,]
[0019] (6) -- said searcher is a preparation thing about a means to carry out weighting to the correlation value for this every error correcting code-ized unit frame according to the error rate estimate for said every error correcting code-ized unit frame. [moreover,]
[0020] (7) -- based on the number of errors which the error rate estimate for said every error correcting code-ized unit frame shows, said searcher computes a weighting factor and carries out the multiplication of this weighting factor to the correlation value for said every error correcting code-ized unit frame. [moreover,]
[0021] (8) -- said searcher is equipped with a means to output said synchronous timing according to this presumed passing speed, with reference to the presumed passing speed of a migration machine, when it is beyond a value with all the numbers of errors of each error correcting code-ized unit frame. [moreover,] (9) -- when said presumed passing speed is more than a certain predetermined rate, it has a means to prevent the output of said synchronous timing. [moreover,]
[0022] Since the judgment information data used by the searcher are data before an error correction (this invention uses the judgment data before an error correction since the time delay is large although the direction of the data after an error correction has few errors.), the information data by which the misjudgment law was carried out exist to some extent.
[0023] Then, error rate presumption is performed after an error correction, and the judgment information data quality check used for pass presumption is performed. And pass timing is detectable with a sufficient precision by determining adoption and the

rejection of the pass timing result presumed with judgment information data by the quality check result.

[0024]

[Embodiment of the Invention] Drawing 1 is the explanatory view of the basic configuration of this invention. The back-diffusion-of-electrons section 11 to which the CDMA receiving set of this invention carries out the back diffusion of electrons of the input signal as shown in (a) of drawing, The detection section 12 which detects the signal which carried out the back diffusion of electrons, and the delay buffer 13 with which the received input signal is accumulated temporarily and delayed, The selection section 14 which chooses and outputs one of these out of the information data signal accumulated in the delay buffer 13, and the pilot signal under current reception, It has the searcher 15 which detects and outputs pass timing from the output signal of the selection section 14, and the back-diffusion-of-electrons code generating section 16 which generates a back-diffusion-of-electrons code based on the output signal of a searcher 15.

[0025] The information data signal accumulated in the delay buffer 13 is inputted into a searcher 15 through the selection section 14, and he returns the judgment data which are the output of the detection section 12 to a searcher 15, and is trying for a searcher 15 to detect pass timing like a pilot signal based on those input signals in the CDMA receiving set of this invention using an information data signal.

[0026] In the pass timing detection in a searcher 15, when using a pilot signal, the selection section 14 carries out the direct output of the pilot signal included in either [of those] both I channels or Q channels of an input signal to a searcher 15. Since a pilot signal is a pattern signal defined beforehand, a searcher 15 measures correlation with the received pilot signal and a known pattern signal.

[0027] Moreover, when using receipt information data, the selection section 14 chooses the receipt information data stored in the delay buffer 13 temporarily, and outputs them to a searcher 15, and a searcher 15 measures correlation with these receipt information data and the judgment data of these receipt information data outputted from the detection section 12.

[0028] In addition, (b) of drawing 1 shows the example of the input signal in I in the case of a pilot signal interpolation form, and Q channels, and (c) of drawing shows the example of the input signal in I in the case of a pilot signal extrapolation form, and Q channels.

[0029] Drawing 2 is the explanatory view of the delay buffer of the input signal in above-mentioned this invention. (a) of drawing shows the configuration which took out the chief section of the configurations of being shown in drawing 1 , (b) of drawing shall show the timing diagram of each signal frame of the A point shown in (a) of drawing, a B point, and C point, the number attached in each signal frame shall show the slot number, and one slot shall consist of data of for example, ten symbols.

[0030] In case information data are used for detection of pass timing in a searcher 15, since the received information data are strange data, they need to carry out the back diffusion of electrons of these information data by the back-diffusion-of-electrons section 11 and the detection section 12, need to detect them, and need to judge information data.

[0031] However, as show in (b) of drawing, in order [which judgment processing take] to carry out time amount part (part for for example, 20 symbols) delay, that the judgment data be send out from C point of the output of the detection section 12 need to

incorporate the information data in signal of an A point to the delay buffer 13, it need to delay by the delay (a part for for example, the 20 above-mentioned symbol), need to input into a searcher 15 the signal of the B point which be the output, and need to double timing.

[0032] Therefore, this information data signal is inputted into a searcher 15 to the timing from which judgment data return to a searcher 15. In addition, the above-mentioned delayed part is time amount which phase presumption mainly takes, and when starting phase presumption in much time amount, a time delay becomes large so much.

[0033] Drawing 3 is the explanatory view of the correlation measurement which uses the correlation output for every predetermined section of the information data signal of this invention. (a) of drawing shows the case of a pilot signal interpolation form, it is drawing (b-1), and (b-2) of drawing shows the case of a pilot signal extrapolation form. As shown in drawing, electrical-potential-difference addition of the correlation output with the judgment data for every predetermined section is carried out to an information data signal, respectively, power addition of the electrical-potential-difference aggregate value of each section is carried out after that, and pass timing is detected.

[0034] From the input signal of a pilot signal interpolation form, when a searcher has only one line like the operation gestalt shown in drawing 1 , as shown in (a) of drawing 3 , to a pilot signal and an information data signal, electrical-potential-difference addition of the correlation value for every symbol is performed, this electrical-potential-difference aggregate value power addition is carried out for every predetermined section, and the small correlation value of distribution is calculated.

[0035] Moreover, since the correlation value of a pilot signal and an information data signal cannot be detected to coincidence to the input signal of a pilot signal extrapolation form when a searcher has only one line, as shown in (b-1) of drawing 3 , a correlation value is measured only to an information data signal. However, the time of communication link initiation etc. performs pass detection using a pilot signal, when it is in the condition that an information data signal is not outputted.

[0036] On the other hand, to the input signal of a pilot signal extrapolation form, when a searcher can detect two signals, as shown in (b-2) of drawing 3 , electrical-potential-difference addition is performed for the pilot signal and information data signal of the same time of day for every (every slot) block, respectively, power addition of the electrical-potential-difference aggregate values of the PAROTTO signal for every block of the same time amount section and information data is carried out after that, and power addition is further performed with the power aggregate values of some blocks. Even in this case, although electrical-potential-difference addition is performed per data block of the predetermined time amount section, let this data block unit be the optimal section length without the effect of the phase rotation by phasing.

[0037] Drawing 4 shows the operation gestalt of this invention which has the searcher which detects two signals. A searcher 45 is equipped with the correlating detector 451 for pilot signals, the correlating detector 452 for information data signals, and the adder 453 that carries out power addition of the correlation electrical-potential-difference aggregate value from those correlating detectors in this drawing. Since other components are the same as that of the thing in the configuration shown in drawing 1 , the explanation which attached the same sign and overlapped is omitted.

[0038] Detection of correlation by such addition can perform electrical-potential-

difference addition in the block unit corresponding to the frame and slot length of W-CDMA to which the present standardization is progressing. That is, since the signal length and period which are predicted that a pilot signal is a signal transmitted in order to make phase presumption of a channel perform, and originally does not usually have the effect of the phase rotation by phasing which happens in a migration environment are set up, correlation is detectable with a sufficient precision by performing electrical-potential-difference addition for every block of a pilot signal.

[0039] Drawing 5 is the explanatory view of the configuration of this invention which returns an error rate and a CRC-check result. The configuration shown in drawing 5 is equipped with the configuration which feeds back the error rate (BER) value for every frame of an error correcting code-ized unit, and the yes-no decision result of this frame by CRC check to a searcher 15 besides the basic configuration shown in drawing 1 .

[0040] That is, the error REITO (BER) presumption section 54 which compares with recoding data and judgment data the error correction section 51 which performs the error correction of the judgment data outputted from the detection section 12, the CRC-check section 52 which performs CRC check of data which performed this error correction, and the recoding section 53 which carries out recoding of the data which performed the error correction, and presumes error REITO is newly formed.

[0041] And by the CRC-check section 52, CRC check is performed per error correction frame, and it investigates whether the error was in each frame. Moreover, error REITO presumption of judgment data is performed by carrying out recoding of the judgment data after an error correction by the recoding section 53, and comparing the judgment data before an error correction with the recoding data after an error correction in the error rate (BER) presumption section 54. Under the present circumstances, when judged with there being no error in this frame by the yes-no decision of CRC check, perfect error REITO presumption is attained.

[0042] The gestalt of operation shown in drawing 5 returns the yes-no decision result outputted from the number of errors and the CRC-check section 42 for every frame outputted from the error rate (BER) presumption section 54 to a searcher 15, and raises the precision of the pass timing detection in a searcher 15. Hereafter, the concrete means is explained.

[0043] Drawing 6 is the explanatory view of pass timing detection of the error correcting code-ized unit of the pilot signal interpolation form by this invention. As shown in this drawing, while performing electrical-potential-difference addition of the correlation value per block of the predetermined length of a pilot signal and an information data signal, the correlation value which carried out power addition of this electrical-potential-difference aggregate value per error-correcting-code-izing, and carried out power addition of the power aggregate value of some correction coding units further is inputted into the pass detector 61 of a searcher 15.

[0044] The output of the pass detector 61 is inputted into the pass timing sending-out gate 62, and the error REITO estimate of the yes-no decision result of the above-mentioned CRC-check section 52 and the error REITO (BER) presumption section 54 is inputted into the pass timing sending-out gate 62. The pass timing sending-out gate 62 determines as follows whether output a pass timing detection result to the back-diffusion-of-electrons code generating section 16 based on these yes-no decision result or error REITO estimate.

[0045] Since I hear that there is an error and it is to the extent that an error correction is impossible for the judgment data which returned to the searcher 15 when the result of CRC check is an error, it considers that the reliability of the pass detection by these information data is low, the pass timing sending-out gate 62 is intercepted, and the pass timing detection result is not made to reflect to the back-diffusion-of-electrons code generating section 16. In addition, the back-diffusion-of-electrons code generating section 16 generates a back-diffusion-of-electrons code succeedingly to the last pass timing, when a pass timing detection result is not inputted.
[0046] When are judged with it being errorless by CRC check and error REITO presumed from recoding data and judgment data becomes beyond a certain value, it considers that the reliability of pass detection is low, the pass timing sending-out gate 62 is intercepted, and the pass timing detection result is not made to reflect to the back-diffusion-of-electrons code generating section 16.
[0047] Drawing 7 is the explanatory view of the pass timing detection by weighting according to error REITO in the case of the pilot signal interpolation form of this invention. As shown in this drawing, while performing electrical-potential-difference addition of the correlation value per block of the predetermined length of a pilot signal and an information data signal Power addition of this electrical-potential-difference aggregate value is carried out per error-correcting-code-izing, and it is the correlation value of the power aggregate value of this error correcting code-ized unit, respectively The correlation value memory 711, 712, and 713 It memorizes. And weighting (W1, W2, W3) according to the error REITO (BER) estimate for every error correcting code-ized unit is carried out to the correlation value of each of this error correcting code-ized unit. The correlation value which carried out power addition of the correlation value of each error correcting code-ized unit which performed this weighting is inputted into the pass detector 73.
[0048] The wait control section 72 outputs the weighting multiplier (W1, W2, W3) according to the error REITO (BER) estimate for every error correcting code-ized unit, and the error REITO (BER) estimate for every error correcting code-ized unit is computed by the error REITO (BER) presumption section 54 shown in above-mentioned drawing 5 . In addition, the correlation value memory 711 which memorizes the correlation value for every error correcting code-ized unit since time gap arises between each error correcting code-ized unit, although error REITO for every error correcting code-ized unit is computed, 712, and 713 It is necessary to have.
[0049] Drawing 8 is the explanatory view of pass timing detection of the error correcting code-ized unit of the pilot signal extrapolation form by this invention. The gestalt of this operation inputs into the pass detector 81 of a searcher 15 the correlation value which performed electrical-potential-difference addition of a correlation value per block of the predetermined length of a pilot signal and an information data signal, respectively, carried out power addition of the electrical-potential-difference aggregate value of the correlation value of a pilot signal and an information data signal by the blocks of the same timing, and carried out power addition of those power aggregate values per error-correcting-code-izing, and carried out power addition of the power aggregate value of the correction coding unit of further some further.
[0050] Like the gestalt of operation shown in drawing 6 also in this case, the output of the pass detector 81 is inputted into the pass timing sending-out gate 72, and the error REITO

estimate of the yes-no decision result of the CRC-check section 42 and the error REITO (BER) presumption section 54 is inputted into the pass timing sending-out gate 82.
[0051] The pass timing sending-out gate 82 determines whether output a pass timing detection result to the back-diffusion-of-electrons code generating section 16 based on these yes-no decision result or error REITO estimate. Although the explanation which overlapped since the decision technique was the same as the case of the pilot interpolation form shown in drawing 6 is omitted, the reflection to the back-diffusion-of-electrons code generating section 16 of a pass timing detection result is similarly controlled by the CRC-check result or the error REITO value.
[0052] Drawing 9 is the explanatory view of the pass timing detection by error REITO weighting in the case of the pilot signal extrapolation form of this invention. As shown in drawing, electrical-potential-difference addition of a correlation value is performed per block of the predetermined length of a pilot signal and an information data signal, respectively. And power addition of the electrical-potential-difference aggregate value of the correlation value of the pilot signal of the same timing blocks and an information data signal is carried out. And it is the correlation value which carried out power addition of those power aggregate values per error-correcting-code-izing, and carried out this power addition The correlation memory 911, 912, and 913 It memorizes. And weighting (W1, W2, W3) according to the error REITO (BER) estimate for every error correcting code-ized unit is carried out to the correlation value of each of that error correcting code-ized unit. The correlation value which carried out power addition of the correlation value of each error correcting code-ized unit which performed this weighting is inputted into the pass detector 93.
[0053] The wait control section 92 outputs the weighting factor (W1, W2, W3) according to the error REITO (BER) estimate for every error correcting code-ized unit like the gestalt of operation shown in drawing 6 , and the error REITO (BER) estimate for every error correcting code-ized unit is computed by the error REITO (BER) presumption section 54 shown in above-mentioned drawing 5 . In addition, the correlation value memory 911 which memorizes the correlation value for every error correcting code-ized unit, 912, and 913 It is the same as that of the case of the gestalt of the operation which also showed the reason which it had to above-mentioned drawing 7 .
[0054] Drawing 10 shows the example of the weighting-factor calculation according to the error REITO estimate for every error correcting code-ized unit in this invention. Drawing (a) The example of the weighting-factor calculation approach when not taking into consideration passing speed of a CDMA receiving set is shown, and (b) of drawing shows the example of the weighting-factor calculation approach at the time of taking passing speed into consideration.
[0055] Now if [set the number of errors in each 1st, 2nd, and 3rd error correcting code-ized unit frames to N1, N2, and N3, respectively, and] Z=N1+N2+N3 The 1st, the 2nd and each weighting factor W1 and W2 to the correlation value of the 3rd error correcting code-ized unit frame, and W3 are W1=(Z/N1)/(Z/N1+Z/N2+Z/N3).
W2=(Z/N2)/(Z/N1+Z/N2+Z/N3)
W3=(Z/N3)/(Z/N1+Z/N2+Z/N3)
It computes by carrying out. In addition, it is set to W1+W2+W3=1.
[0056] Each weighting factors W1 and W2 and W3 serve as a value which was in inverse proportion to the number of errors within a self-block, respectively. That is, it becomes

the multiplier of such a small value that there are many errors, and becomes the multiplier of such a big value that there are few errors. Thus, the precision of a correlation value can be raised by carrying out the multiplication of the weighting factor according to the inverse number of the number of errors to the correlation value of each block. In addition, although this example shows the example which computes three correlation values using an error correcting code-ized unit frame, of course, a frame number is not limited to this.

[0057] Furthermore, as shown in (b) of drawing, also refer to the presumed passing speed, for example, when N1, N2, and N3 errors of each frame are beyond a certain values altogether When the presumed passing speed V is below a certain rate Vfast, do not reset pass timing but it is made to operate to the last timing with reference to the presumed passing speed V at that time, and it is made to reset when the presumed passing speed V is more than a certain rate Vfast.

[0058] This is because it is more accurate to have considered the pass condition not to change so much, and to perform the back diffusion of electrons to the last pass timing when there are very many errors when the presumed passing speed V is below a certain rate Vfast in many cases.

[0059] In addition, the presumed passing speed V can be presumed by measuring for example, a phasing fluctuation frequency (count to which phasing fluctuation level intersects per unit time amount in a predetermined level value) etc.

[0060] When either with N1, N2, and N3 errors of each frame is below a certain value, pass timing can be detected with a sufficient precision by calculating a weighting factor by the calculation approach as shown in (a) of above-mentioned drawing 9 , and detecting pass timing based on the correlation value which carried out power addition of the correlation value which carried out the multiplication of this weighting factor

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the explanatory view of the basic configuration of this invention.

[Drawing 2] It is the explanatory view of the delay buffer of the input signal in this invention.

[Drawing 3] It is the explanatory view of correlation measurement using the correlation output for every predetermined section of the information data signal of this invention.

[Drawing 4] It is the explanatory view of the operation gestalt of this invention which has the searcher which detects two signals.

[Drawing 5] It is the explanatory view of the configuration of this invention which returns an error rate and a CRC-check result.

[Drawing 6] It is the explanatory view of pass timing detection of the error correcting code-ized unit of the pilot signal interpolation form by this invention.

[Drawing 7] It is the explanatory view of the pass timing detection by weighting according to error REITO in the case of the pilot signal interpolation form of this invention.

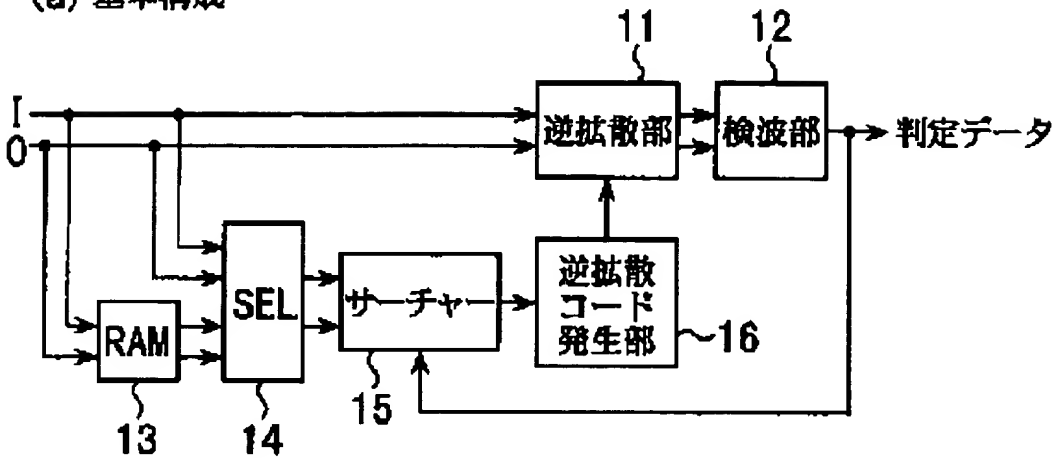
[Drawing 8] It is the explanatory view of pass timing detection of the error correcting code-ized unit of the pilot signal extrapolation form by this invention.

[Drawing 9] It is the explanatory view of the pass timing detection by error REITO

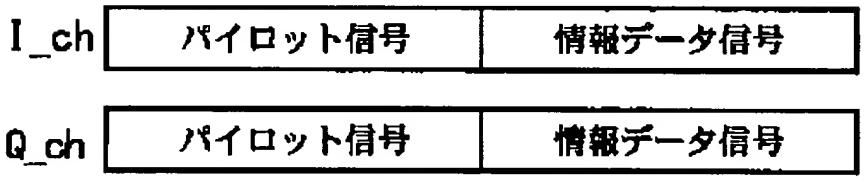
weighting in the case of the pilot signal extrapolation form of this invention.
[Drawing 10] It is drawing showing the example of the weighting-factor calculation according to the error REITO estimate for every error correcting code-ized unit in this invention.
[Drawing 11] It is the explanatory view of the pass timing detection by the conventional pilot signal.
[Description of Notations]
11 Back-Diffusion-of-Electrons Section
12 Detection Section
13 Delay Buffer
14 Selection Section
15 Searcher
16 Back-Diffusion-of-Electrons Code Generating Section

本発明の基本構成の説明図

(a) 基本構成



(b) パイロット信号内挿形



(c) パイロット信号外挿形

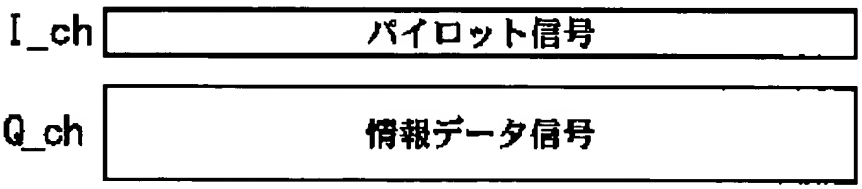


Figure 1

本発明における入力信号の遅延バッファの説明図

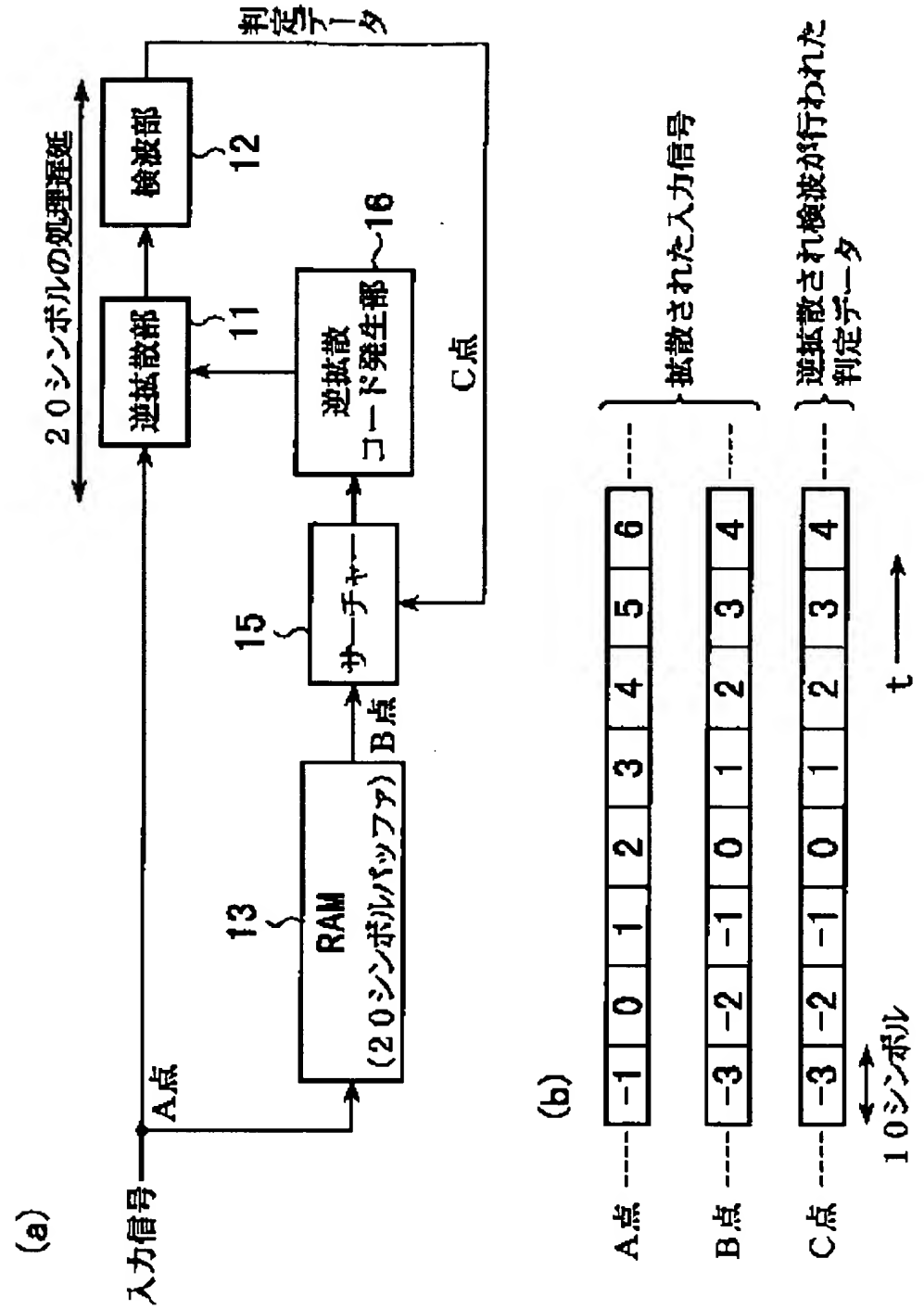


Figure 2

本発明の情報データ信号の所定区間毎の相関出力を用いる
相関測定の説明図

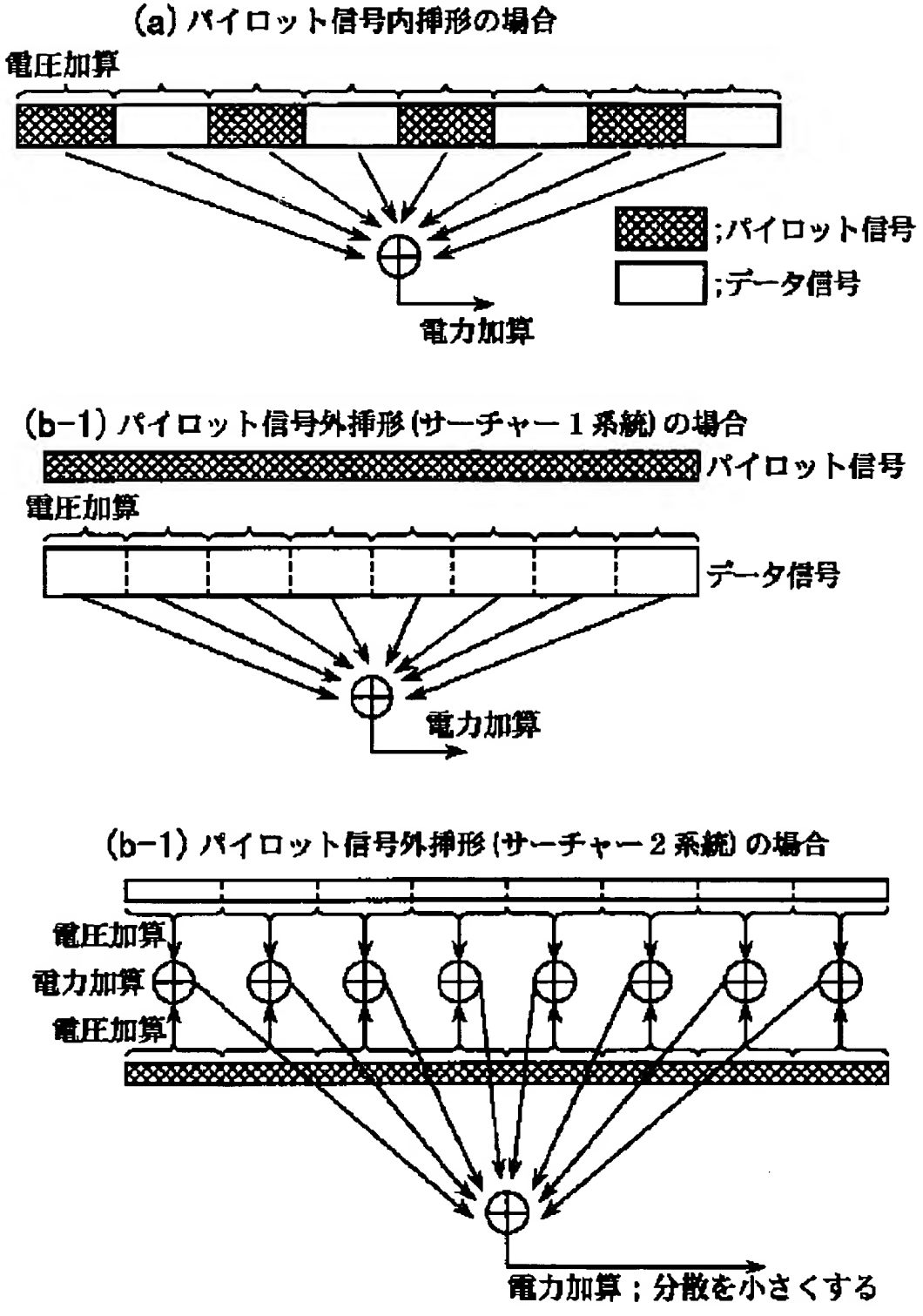


Figure 3

２系統の信号を検出するサーチャーを有する
本発明の実施形態の説明図

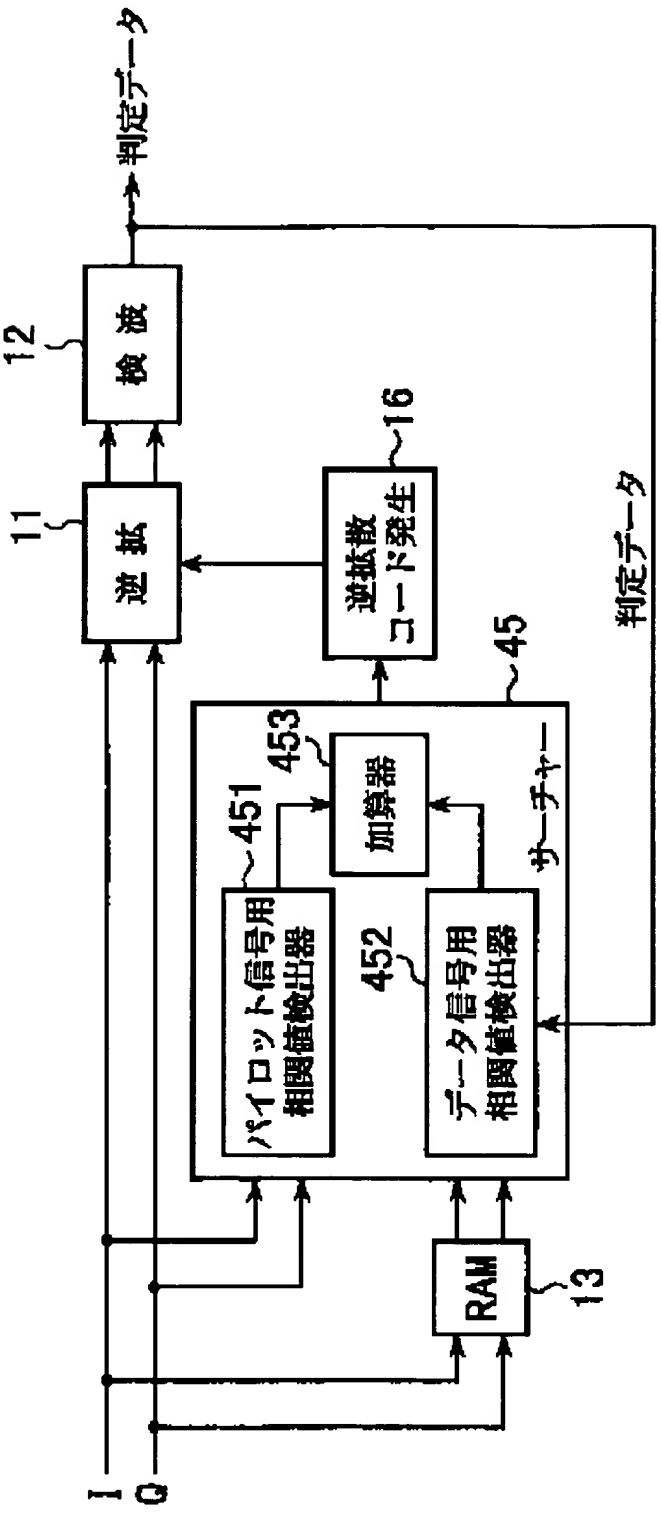


Figure 4

エラーレイトとＣＲＣチェック結果を帰還する本発明の構成の説明図

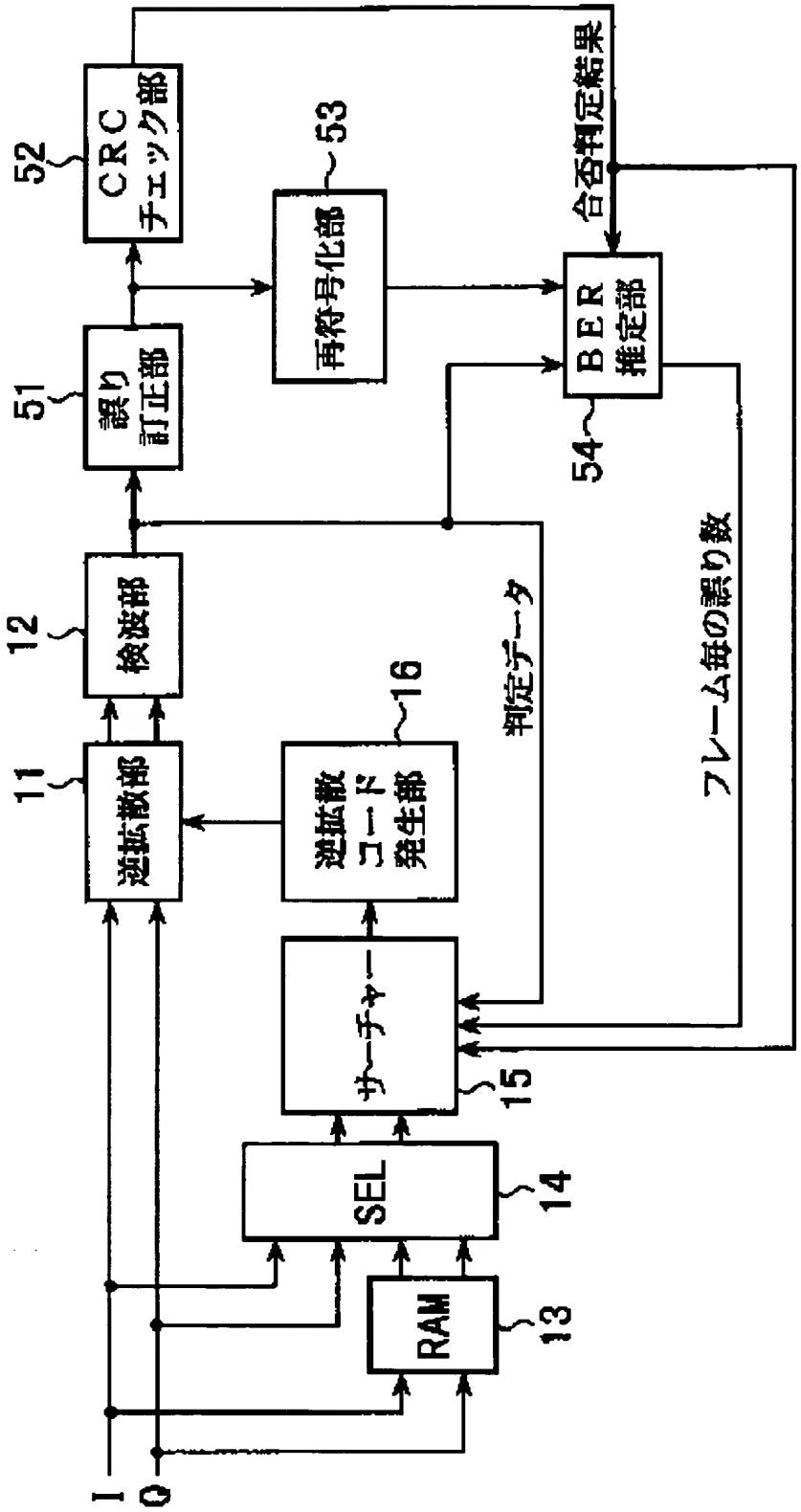


Figure 5

本発明によるパイロット信号内挿形の誤り訂正符号化単位のパスタイミング検出の説明図

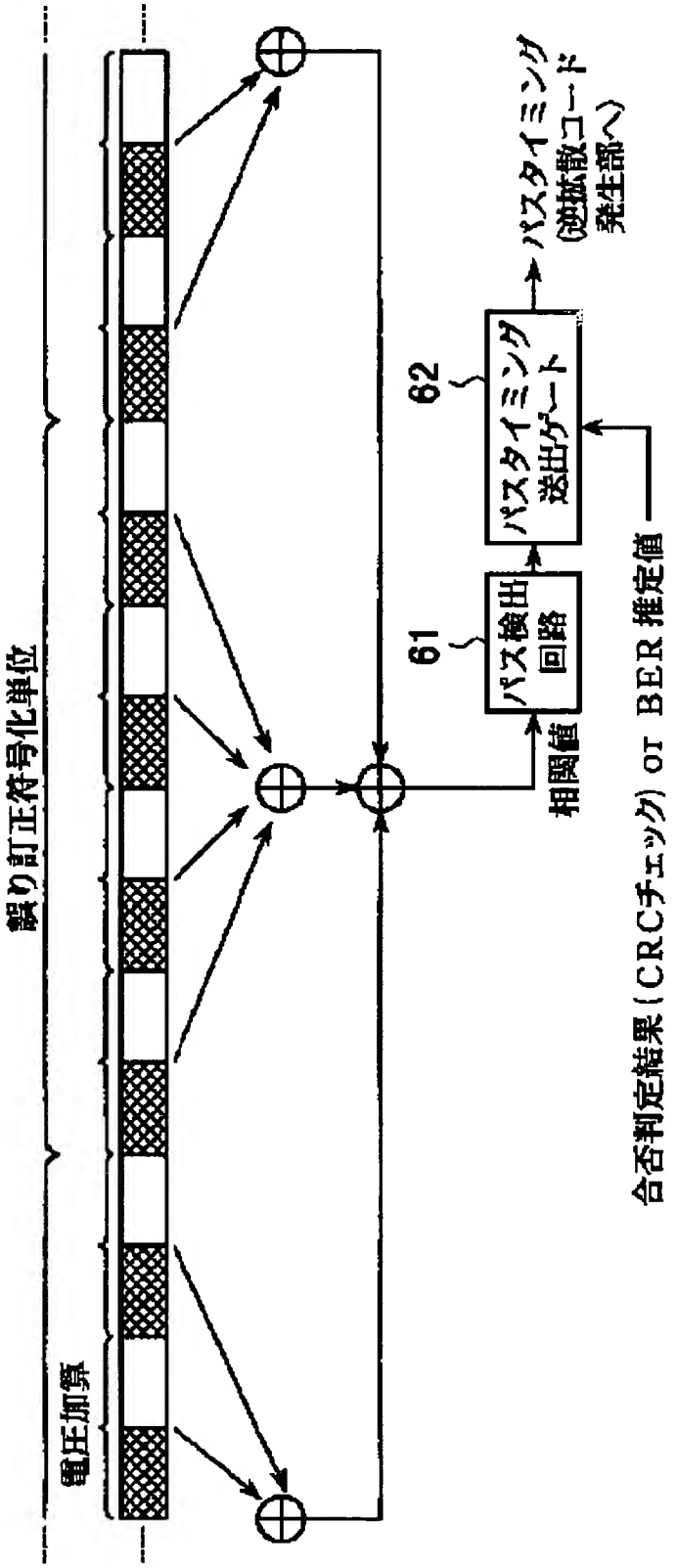


Figure 6

本発明のパイロット信号内挿形の場合のエラーレイトに応じた重み付けによるパスタイミング検出の説明図

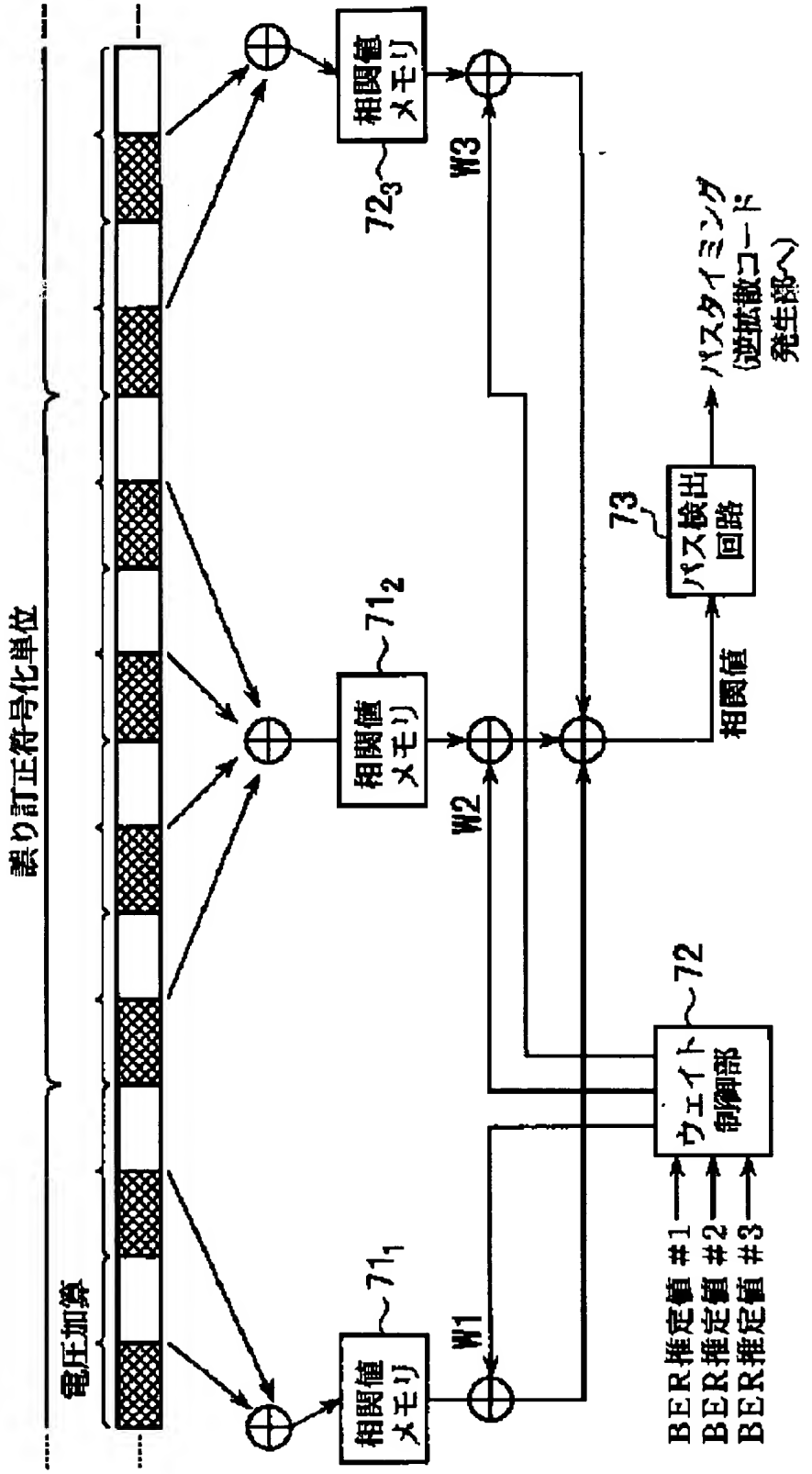


Figure 7

本発明のパイロット信号外挿形の誤り訂正符号化単位のパスタイミング検出の説明図

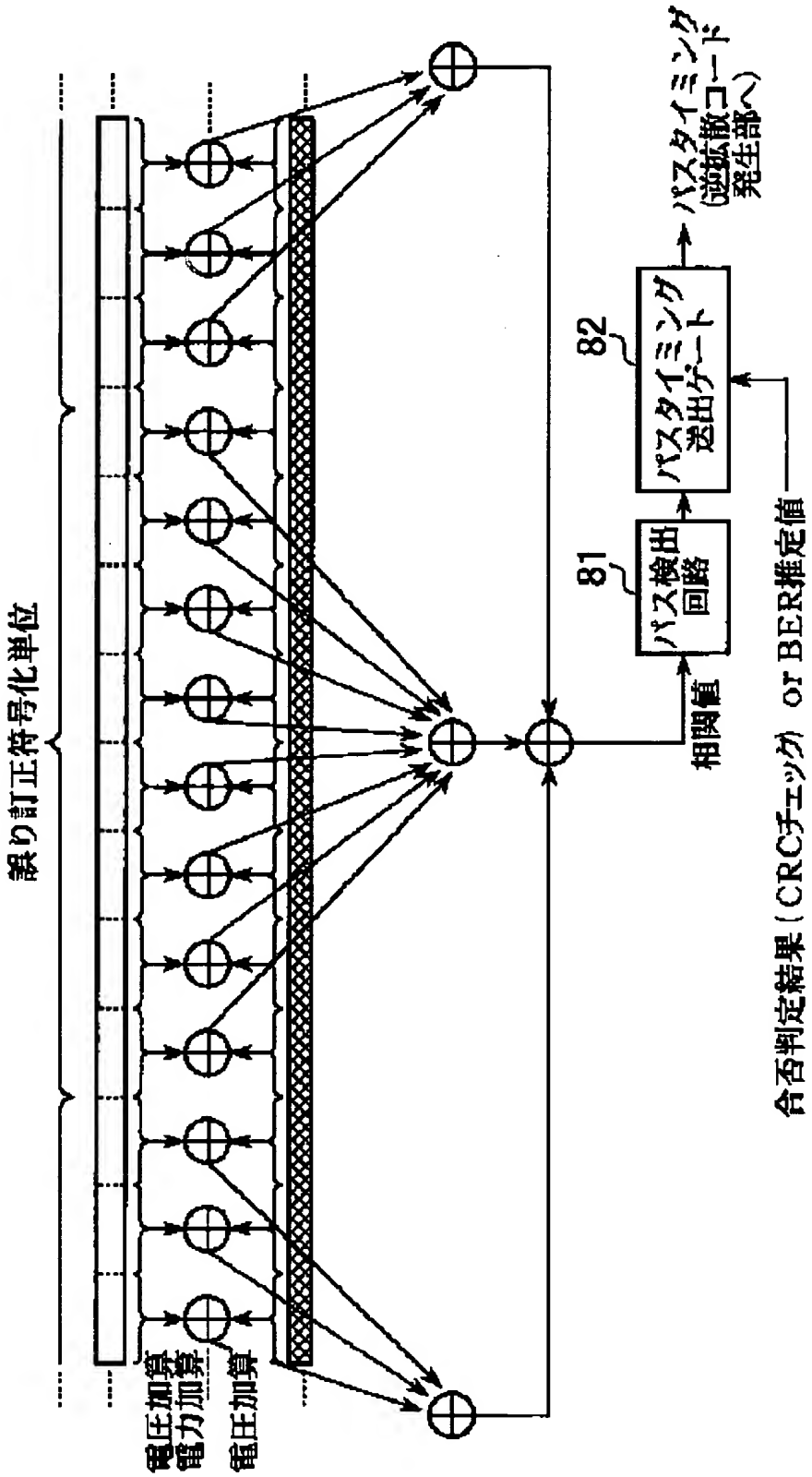


Figure 8

本発明のパイロット信号外挿形の場合のエラーレイト重み付けによるパスタイミング検出の説明図

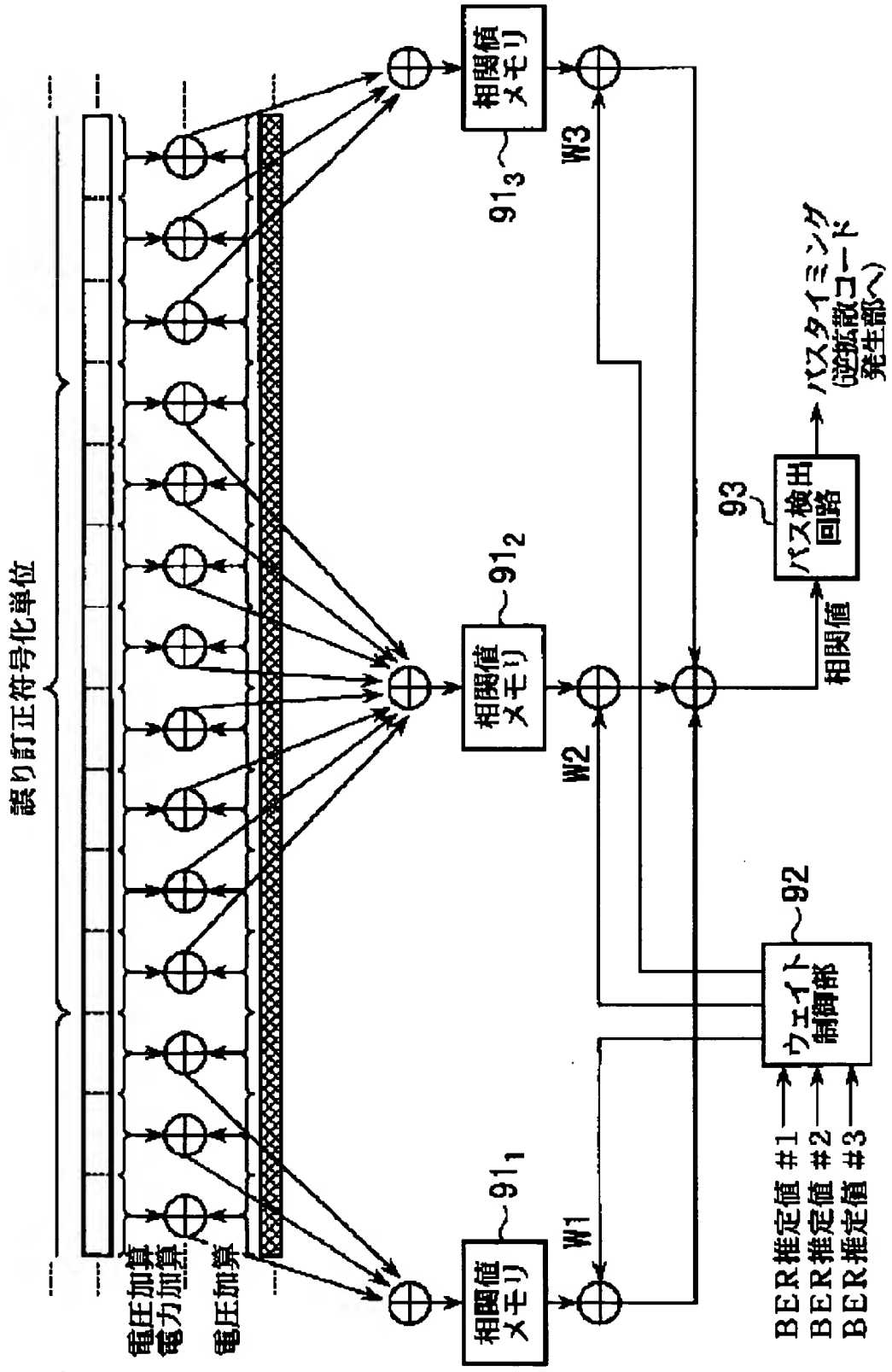


Figure 9

本発明における誤り訂正符号化単位毎のエラーレイト推定値に応じた重み係数算出の例

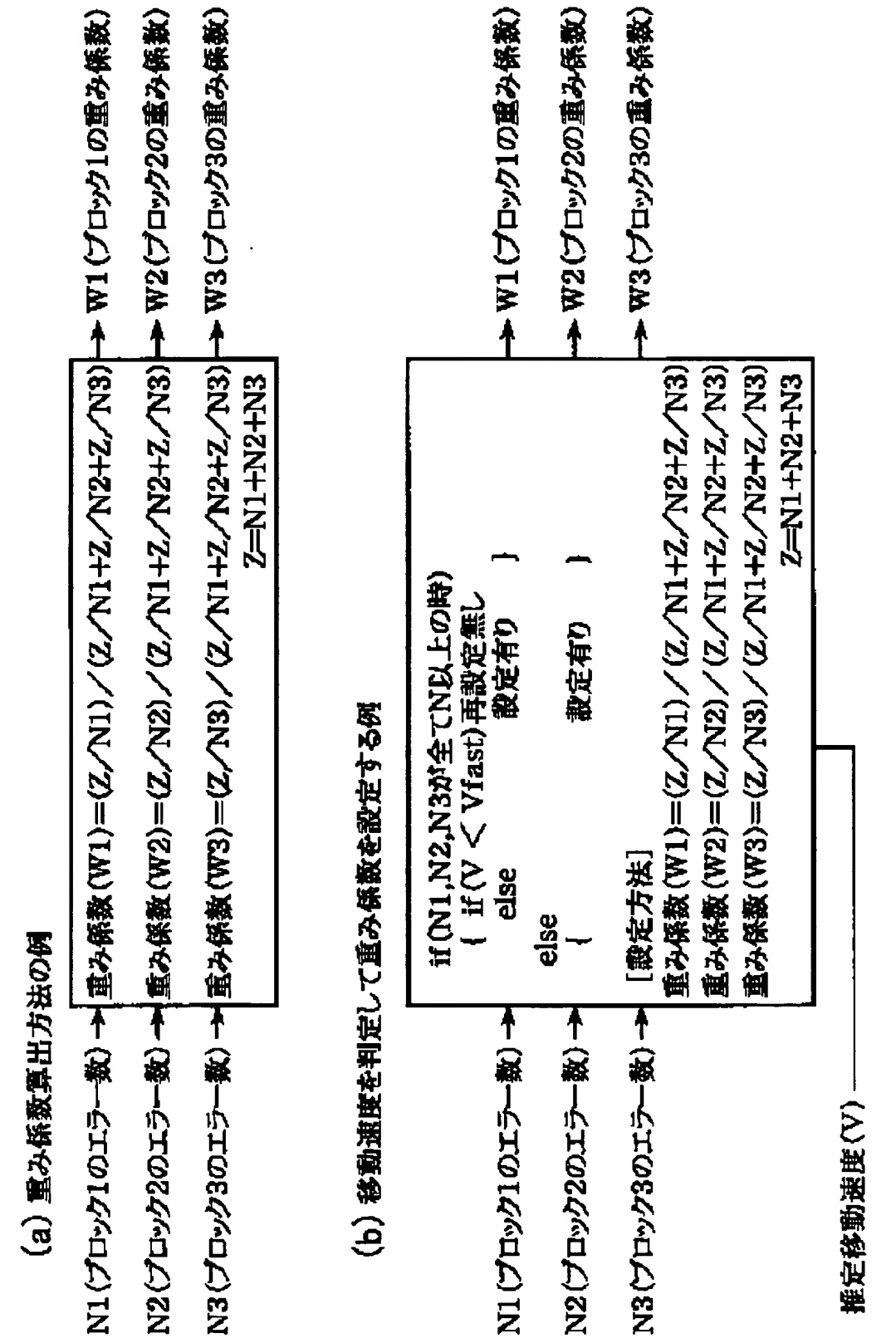


Figure 10

従来のパイロット信号によるパスタイミング検出の説明図

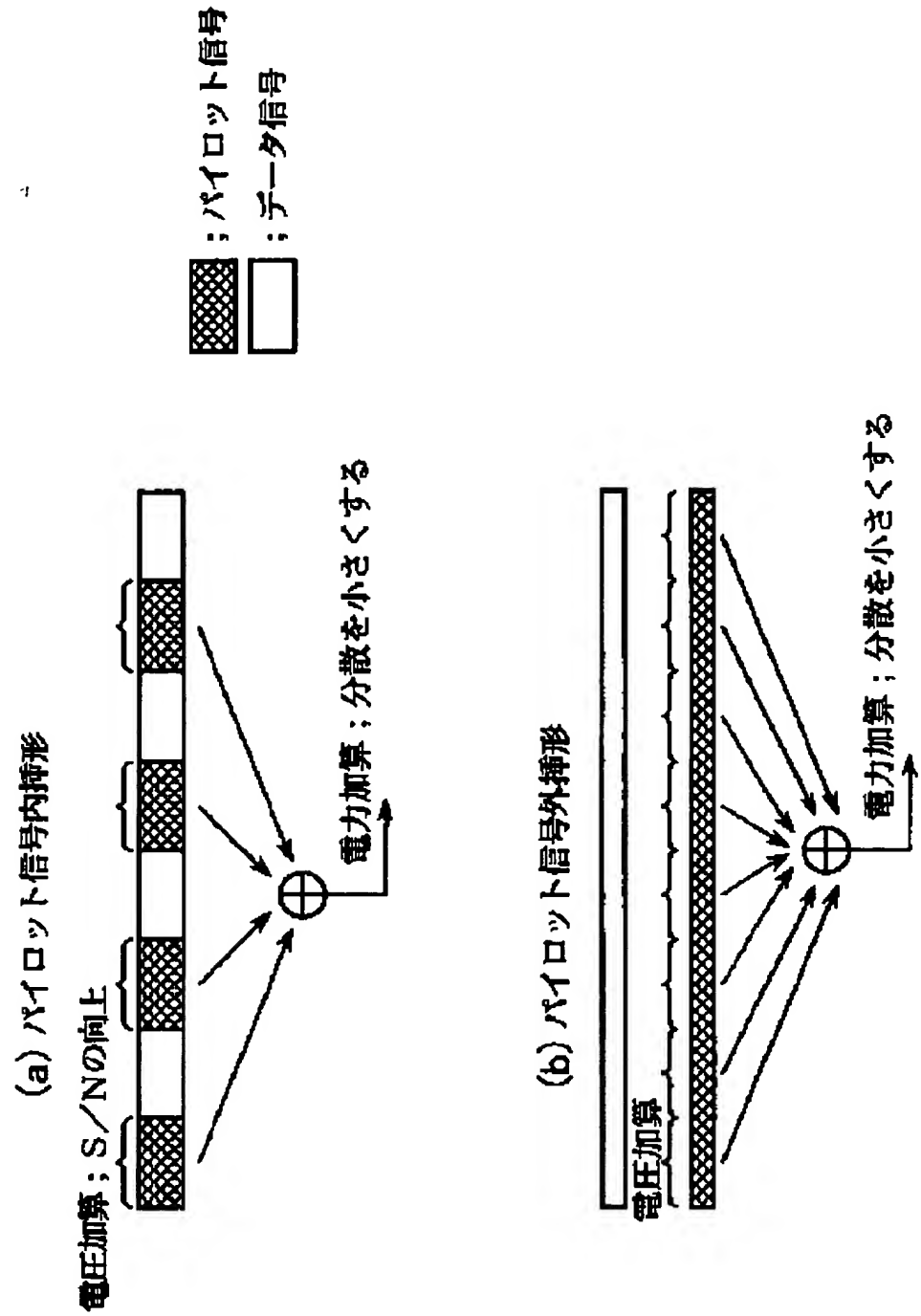


Figure 11